Electronically Distributed, Computer-Generated, Individualized Feedback Enhances the Use of a Computerized Practice Guideline

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Clinical guidelines have been developed to assist with the management of patient care; however, these guidelines are frequently neglected in clinical practice. Computer-generated reminders enhance guideline use, but these systems often fail to achieve high rates of guideline utilization. This study was designed to test the hypothesis that computer-generated, individualized feedback regarding adherence to care guidelines will significantly improve clinician compliance with guideline recommendations presented through a computer-assisted management protocol. Half of the 45 primary care clinicians employed at a primary care clinic affiliated with an academic medical center, were randomized to receive a biweekly electronic mail message consisting of a computer-generated report summarizing his/her response to care guideline recommendations for the diabetic patients seen during the previous 2 weeks. Clinician compliance with guideline recommendations was the primary outcome measure. This study demonstrated that the intervention significantly increased clinician compliance with the guideline recommendations without incurring high maintenance expenses. Median compliance among the intervention group was 35% versus 6.1% among the control group ($p<0.01$). Electronically distributed, computer-generated, individualized feedback regarding clinician use of care guideline recommendations is an effective way to enhance compliance with a care guideline.

INTRODUCTION

Numerous clinical practice guidelines have been developed to assist clinicians with the management of specific diseases [1]. Unfortunately, many of these guidelines are not utilized in the clinical setting [2]. Several approaches, such as computer-generated reminders, have been shown to enhance guideline utilization; however, even the best of these approaches fails to achieve high rates of utilization [3-9]. Individualized feedback to clinicians has been shown to improve their compliance with guidelines alone or in conjunction with other decision support systems [10-13]. Previous uses of feedback, however, have often been labor and cost intensive and, consequently, have been difficult to sustain [10,12,13]. The focus of this study was to develop and evaluate a computer-generated feedback system that required minimal maintenance by exploiting the internet for electronic distribution of the feedback messages to clinicians. None of the previous studies used electronic mail for conveying feedback. The study hypothesis was that electronically distributed, computer-generated, individualized feedback concerning guideline utilization would significantly enhance utilization while requiring minimal resource allocation for long term maintenance.

METHODS

Study Site and Participants

The study was conducted at the Duke Family Medicine Center (DFMC), a free-standing, full service primary care clinic and family medicine resident training site affiliated with Duke University Medical Center. DFMC uses a computer-based patient record (CPR) known as The Medical Record (TMR) for demographic information, problem lists, quality assurance reminders, study results, pharmacy data including immunizations, and several other clinical and administrative functions [14,15]. Additionally, TMR runs a Computer-Assisted Management Protocol (CAMP) based on a chronic care guideline for diabetes mellitus that has been shown to significantly improve compliance with guideline recommendations [3,16]. The CAMP prints eight patient-adapted recommendations derived from a consensus practice guideline developed at DFMC on the bottom of the first page of the clinic's paper encounter form. The CAMP has been in consistent use at DFMC since September, 1993. Electronic mail (Lotus cc:Mail) is extensively used at DFMC for administrative communication but had not been used for repeated transmission of clinical information prior to this study. All 45 of the clinic's primary care clinicians were randomized to either the control or intervention group. Randomization was stratified by training level.

CAMP Audit Program

We programmed an audit application to detect the ordering of the laboratory tests or immunizations

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recommended by the CAMP. The program extracts patient and encounter identification data from a master file along with the recommendations that were given by the CAMP during each encounter over a date range specified by the user. It then accesses the CPR to determine which tests and immunizations were ordered and which problems were assessed during the encounter. Based on this information, the program sends email to the clinician summarizing his/her use of the guideline recommendations and writes a copy of each message along with a data summary to an output file for monitoring compliance in this study. A sample feedback message is shown in Figure 1.

The audit program was extensively tested on over 500 actual patient encounters until no discrepancies were noted between the prompt information printed on the paper encounter form, the patient's computer-based medical record and the information contained in the feedback messages.

The reliability of the computer-based audit program was established through extensive chart audits done as part of an earlier study [3]. Data extracted from a patient's paper medical record and CPR were contrasted with the findings of the audit program. Reliability was calculated as the number of instances in which the manual and computer audit agreed over the total number of recommendations. To standardize the manual chart auditing process all of the audits were performed by the same clinician (DFL) using a formalized audit protocol.

The Feedback Intervention

Clinicians randomized to the intervention were informed by email prior to the onset of the study that they would be receiving feedback about their use of the CAMP recommendations. The study was conducted over a 12 week period. Email feedback messages were generated biweekly by manually running the audit program. Messages were automatically encrypted by the email system. The initial 4 weeks (2 cycles) of the study were designated as a phase-in period for the intervention prior to collecting compliance data. The phase-in period was needed since awareness of the intervention was hypothesized to be necessary to influence clinician behavior.

provider: marcus welby
you saw the following diabetic patients from 01/01/00 to 01/14/00.

	hgba1c	ur-prot	choles	influ	pneumov
lynn theresa smith	d/d	nd/nd	nd/d	nd/nd	d/nd
01/01/00					
diabetes evaluated					
holly elizabeth phillips	d/d	d/nd	d/d	d/nd	d/nd
01/01/00					
diabetes evaluated					
celestine miller	d/nd	nd/nd	nd/nd	d/d	d/d
01/08/00					
diabetes evaluated					

during this interval you evaluated 3 patient(s) for diabetes. among these patient(s), 10 recommendation(s) was(were) due and 5 recommendation(s) was(were) done. (50% completion).
KEY:
d/ = recommendation listed as "due now" in the diabetes qa prompts
nd/ = recommendation listed as "not due"
/d = completion of recommendation detected by computer, i.e., "done"
/nd = completion of recommendation not detected by computer, i.e., "not done"
hgba1c = chronic blood glucose control as measured by hgba1c or glycohgb

The above information is generated by a computerized review of the patient's electronic medical record for a research project. As an automated system, it may fail to adequately reflect exactly what was done during an encounter. The goal of providing this information to you is to help you to enhance your use of the practice care guidelines for diabetes mellitus. This data will NOT be used to identify individual providers' practice patterns, but to monitor the practice as a whole. It is recognized that there are often compelling reasons not to follow certain recommendations; in these instances the provider always has the final say.

Figure 1. Sample Email Message of Computer-Generated, Individualized Feedback and Disclaimer.

Data Collection and Analysis

Prior to initiation of the study a minimal exposure level for diabetic patient care was set at one encounter in which diabetes was assessed every two weeks. Minimal exposure criteria were necessary to ensure that compliance rates were derived from multiple encounters. Clinician compliance with minimal standards of care was calculated as the number of recommendations performed over the number of recommendations due during all of the encounters for which the clinician indicated that diabetes was assessed. Deriving compliance data only from encounters in which diabetes was assessed was consistent with the practice-derived guideline stipulating that compliance was only expected for encounters in which diabetes was a focus problem. Diabetes was considered assessed if a clinician marked it on the problem list of the paper encounter form. This information was entered into the CPR at the time of patient check out. The restriction of compliance data to encounters in which diabetes was assessed eliminated patients who were erroneously labeled as diabetic as well as patients who were followed for diabetes elsewhere. Comparison of clinician compliance rates between the intervention and control groups was done using a two-tailed Wilcoxon rank sum test.

Survey of User Opinions

At completion of the study, users were emailed a user satisfaction survey to determine whether clinicians had read feedback messages and what they thought about the feedback system (survey content detailed in Table 2). Survey responses were tallied as the percent of clinicians selecting each answer. The survey was resent to all non-responders electronically after 1 week and on paper after 2 weeks. One user was not surveyed because he saw no diabetic patients during the data collection phase.

RESULTS

Reliability of the Audit Program

The electronic audit program was 97% reliable when compared with data from chart/CPR audits of 1098 encounters involving 5370 recommendations. Discrepancies occurred between electronic audit and chart reviews primarily because information recorded in the paper chart documenting compliance was not available electronically, e.g., failure to capture the administration of an immunization in the CPR.

Exposure to Diabetes Care

Clinician contact with diabetic patients following the 4-week phase-in period is summarized in Table 1.

Table 1. Exposure to Diabetic Patient Care.

Number of:	Ctrl	Intv
Clinicians	23	22
Total Encounters	227	229
Encounters/ Clinician	9.9	10.4
Encounters with Diabetes Assessed	110	95
Recommendations Due	209	168
Recommendations Done	25	57
Recommendations Due/Encounter	1.90	1.77
Recommendations Done/Encounter	0.23	0.60
Encounters with Diabetes Not Assessed	117	134
Recommendations Due	240	418
Recommendations Done	6	25
Recommendations Due/Encounter	2.05	3.12
Recommendations Done/Encounter	0.05	0.19

Ctrl = control group Intv= intervention group

The total number of encounters and the number of encounters per clinician is similar in both groups. In 48.5% of encounters with control clinicians and 41.5% of encounters with intervention clinicians diabetes was assessed. The number of recommendations "due" during these encounters was similar in both groups. Fewer recommendations were completed per encounter if diabetes was not assessed. Eleven clinicians in the control group and nine clinicians in the intervention group fulfilled the criteria for minimum exposure to diabetes care. Compliance rates were calculated for these clinicians to evaluate the effect of the intervention. The control group consisted of 7 faculty clinicians, 2 third-year residents, and 2 first-year residents. The intervention group included 6 faculty clinicians, 1 third-year resident, and 2 second-year residents.

Effect on Compliance

Comparison of compliance rates between the intervention and control groups is shown in Figure 2. The clinicians receiving feedback had a statistically significantly higher median level of compliance than the clinicians in the control group ($p<0.01$, two-tailed). Median compliance for the intervention group was 35.3%, for the control group, 6.1%. Group

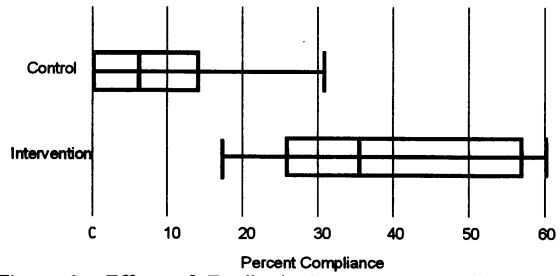

Figure 2. Effect of Feedback System on Compliance. The rectangles encompasses the 25th to 75th percentile. The heavy vertical line in the rectangle denotes the group median. Horizontal lines capped with a vertical cross bars delineate the range of values for each group.

median compliance rates among clinicians meeting the minimal exposure criteria for diabetes care during the 4-week phase-in period were not statistically significantly different.

Estimated Maintenance Costs

The ongoing maintenance requirement for the feedback system is five minutes of a programmer's time each month to run the audit program manually to generate biweekly feedback messages. The annual cost for this level of maintenance is under $100. Plans are in place to automate the biweekly running of the audit program. Following this additional automation, the maintenance costs of the system will be further reduced.

User Responses to Survey

All except one clinician who had received feedback messages responded to the user survey (95% response rate). Results of this survey are shown in Table 2. In general clinicians read the feedback messages, felt the feedback information was similar to their expected level of compliance, agreed that the feedback system had a positive effect on their practice behavior, and viewed receipt of feedback messages as a positive intervention. In addition, all respondents endorsed practice guidelines as beneficial for patient care.

DISCUSSION

This study shows that electronically transmitted feedback significantly improves clinician compliance with care guideline recommendations with minimal maintenance overhead. It also shows that clinicians have favorable attitudes toward electronically mailed feedback and welcome its receipt. Additionally, the study demonstrates that data routinely collected in an electronic medical record can be reliably audited by computer to provide clinicians with feedback about their practice patterns. The impact of these findings on patient care are limited because the endpoint was compliance, not outcome. The underlying assumption that improved guideline compliance will result in better patient outcomes remains to be demonstrated.

While the feedback intervention significantly enhanced the use of the diabetes care guideline recommendations, this intervention is not the final solution to the guideline utilization problem. Even with the intervention, median compliance was under 50%. This low level of compliance occurred in a setting in which clinicians favored the use of practice guidelines and participated in development of the consensus guideline. While this favorable view of guidelines lessens the likelihood that disagreement with the guideline hindered compliance, clinicians' responses to the survey noted failure to comply due to lack of perceived benefit of specific recommendations in certain cases, possible risk or discomfort to the patient, absence of the paper chart to confirm computer-generated recommendations, and unintentional neglect of the recommendations.

The low baseline median compliance rate underscores the fact that the impact of reminders alone is limited. Thus, innovations such as the automated guideline feedback system developed in this study are needed to augment guideline utilization on an on going basis. The lower level of baseline compliance detected in this study relative to previous evaluation of CAMP effectiveness is in part due to the fact that compliance rates in this study were based solely on the performance of recommendations without the additional credit for compliance based on documentation of intent to perform recommendations. The additional boost to compliance rates from including intent to comply is estimated at 10-20% of the total compliance rate.

The electronic audit program assessed compliance well. While a small percentage of discrepancies were detected, nearly all of these errors reflected failure to document the details of the encounter electronically (e.g., clinician's plans for future visits, patient's preferences) as recorded in the paper progress note, versus the actual ordering of studies/procedures. Electronic capture of these details may become possible when the patient record becomes fully electronic, and the paper chart is eliminated.

Feedback distribution using electronic mail was

Table 2. Results of User Survey.

Question Focus	Response (Percent of clinicians selecting each response)					No Response
Reading Feedback Messages	always 52%	frequently 24%	usually 19%	rarely 0%	never 0%	5%
Self Expectation of Utilization	less than expected 33%		same as expected 52%	more than expected 5%		10%
Effect of Feedback Information	increased guideline use 62%		did not effect guideline use 29%	decreased guideline use 5%		9%
Attitude about Feedback	like feedback 52%		neutral toward feedback 38%	dislike feedback 5%		5%
Guideline Effect on Patient Care	beneficial 95%		little influence 0%	detrimental 0%		5%

well received by clinicians and offers several advantages. Email enables clinicians to receive feedback as part of their daily work routine without requiring access to a CPR. This improved access potentially reduces the lag time between when the feedback summary is available and when it is reviewed thus making the feedback more timely. Email also provides access from multiple sites, a paper-free, predefined route for distribution, and a mechanism for tracking receipt.

From this study, it is not possible to conclude that feedback information alone was the decisive factor for influencing clinician behavior. Conceivably, biweekly reminders encouraging use of the diabetes guideline recommendations could have been equally effective. In any case, however, the feedback-based intervention was effective and was favorably received.

It is unlikely that the Hawthorn effect had significant impact on the study result. Since the practice research committee considered data collected in this study to be an extension of ongoing quality assurance activities at DFMC, clinicians were not aware of the evaluative component of the feedback intervention.

Findings from this study support the continuous quality improvement philosophy that most clinicians desire to do what is best for their patients and will significantly alter their behavior in response to non-punitive interventions that assist them to achieve changes for the better. The implications of this tenant are that CPR systems need to be designed to capture data elements from which clinician feedback can be derived and that additional cost effective, low maintenance, non-punitive approaches are needed to further enhance the use of practice guidelines.

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